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**FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY**

January 21, 1994

Mr. William F. Caton
Office of the Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554

Dear Mr. Caton:

On behalf of Hammett & Edison, Inc., Consulting Engineers, three copies of the enclosed comments to Engineering Technology Docket 93-62, concerning Commission adoption of the ANSI/IEEE C95.1-1992 RFR standard, are enclosed. The deadline for comments to this docket is January 25, 1994, so these comments are timely filed.

Sincerely,

Dane E. Ericksen

tg

Enclosures (3)

cc: Mr. Kenneth J. Brown, Capital Cities/ABC, Inc. (w/encl.)
Christopher D. Inlay, Esq. (w/encl.)
Mr. Michael S. Newman, C.S.I. (w/encl.)
Mr. Alan W. Parnau, P.E., CBS Radio (w/encl.)
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Comments of
Hammett & Edison, Inc.
Consulting Engineers

ET Docket 93-62

In the Matter of Guidelines
for Evaluating the Environmental
Effects of Radiofrequency Radiation

January 21, 1994



HAMMETT & EDISON, INC.
CONSULTING ENGINEERS
SAN FRANCISCO

Comments: ET Docket 93-62

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Executive Summary

Hammett & Edison, Inc., Consulting Engineers, has extensive experience calculating, measuring, and, where appropriate, mitigating radio frequency exposure conditions. Despite our initial and continuing opposition to some portions of the IEEE C95.1-1991 Standard, it is nevertheless our belief that the Commission *should* adopt the new ANSI/IEEE C95.1-1992 Standard as the successor guideline to the ANSI C95.1-1982 Standard presently in use by the Commission.

Such adoption, however, is recommended with four important conditions:

- 1) The Commission should pre-empt, albeit on a limited basis, the promulgation by non-federal agencies of RF standards that are more restrictive.
- 2) The Commission should specify threshold distances for all classes and services of stations, beyond which no consideration of RF radiation effects need be made, but within which account must be taken of every such station.
- 3) The Commission should standardize the measurement device interface and the minimum observer effective height for induced body current measurements.
- 4) The Commission should hold in abeyance any requirement for measuring induced or contact body currents above 30 MHz until such time as reliable measurement devices are commercially available.



Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

Notice of Proposed Rule Making

Guidelines for Evaluating the
Environmental Effects of
Radiofrequency Radiation

ET Docket No. 93-62

RECEIVED
JAN 25 1994
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

To: The Commission

Comments of Hammett & Edison, Inc.

1. The firm of Hammett & Edison, Inc., Consulting Engineers, respectfully submits these comments in the above-captioned proceeding relating to radio frequency radiation ("RFR") guidelines. Hammett & Edison, Inc. is a professional service organization that provides consultation to commercial and governmental clients on communications, radio, television, and related engineering matters.

I. Qualifications of Hammett & Edison, Inc.

2. Hammett & Edison, Inc. is well qualified to make comments on this matter, which has the potential to impact significantly the design and continued operations of all broadcast stations in the United States. In 1985 we assisted in the drafting of Office of Science and Technology Bulletin No. 65 (OST-65). In 1987 we petitioned the Commission for a declaratory ruling regarding certain aspects of RFR compliance that had proven to be problematic. That petition resulted in General Docket No. 88-469,¹ which established a categorical exemption for broadcast stations that, by themselves, contribute no more than 1% of their ANSI limit, established a definition for a "broadcast site," and clarified the minimum distance at which intense localized fields from re-radiating metallic objects were to be measured.

3. Hammett & Edison is an industry leader in the computer modeling of ground-level and on-tower power densities at multi-station sites. We also have extensive practical experience in conducting on-site RFR surveys of broadcast sites. Multi-station sites surveyed by us include the Mt. Wilson antenna farm near Los Angeles, the Sutro Tower in San Francisco, the San Bruno Mountain antenna farm near San Francisco, the Walnut Grove antenna farm near Sacramento, Farnsworth Peak near Salt Lake City, South Mountain Park near Phoenix, and the Black Mountain antenna farm near Las Vegas.

¹ General Docket No. 88-469, "In the Matter of Request for Declaratory Ruling: Section 1.1307(b); radiofrequency radiation compliance."



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4. Hammett & Edison has attempted to participate in the development of the new Institute of Electrical and Electronic Engineers (IEEE) C95.1-1991 Standard since 1990, albeit with varying degrees of success. A Hammett & Edison representative has attended all meetings of Subcommittee 4 (SC-4, "Safety Levels With Respect to Human Exposure, 3 kHz-300 GHz") of IEEE Standards Coordinating Committee 28 (SCC28, "Non-Ionizing Radiation") since the November 1992 meeting, and is now a member of SC-4. Further, we expect to continue to attend those meetings and to provide direct input now to SC-4 decisions that are likely to have an impact on broadcast stations, cellular radio stations, and other intentional emitters of radio frequency energy.

II. Hammett & Edison Does Not Oppose FCC Adoption of ANSI/IEEE C95.1-1992

5. Hammett & Edison has long advanced its concerns about certain technical shortcomings in the IEEE standard, beginning in 1990 when the standard was still in its draft stages. Unfortunately, those concerns were never given an adequate hearing by IEEE, despite the best efforts of the firm, and IEEE adopted its C95.1-1991 Standard without resolving those concerns to our satisfaction.

6. When the American National Standards Institute (ANSI) issued a public notice of the proposed adoption of IEEE Standard C95.1-1991, as a successor to ANSI C95.1-1982, it asked for comments concerning the proposed action from any interested parties.² In response to that notice Hammett & Edison filed on April 17, 1992, a formal appeal objecting to the IEEE standard, on the grounds that due process had not been given in the development of that standard, and on the grounds that the standard did not reflect industry consensus. On November 18, 1992, the Bureau of Standards Review (BSR) of ANSI adopted IEEE C95.1-1991 as a successor to ANSI C95.1-1982, as ANSI/IEEE C95.1-1992 (hereinafter "ANSI 1992"), subject, of course, to resolution of the Hammett & Edison appeal.

7. On February 4, 1993, a hearing was held in New York City before the BSR, either to affirm or dismiss the Hammett & Edison objection to ANSI 1992. Others joining the Hammett & Edison appeal were Capital Cities/ABC, Inc., CBS Radio, the engineering consulting firm of C.S.I. Telecommunications, Greater Media, Inc., the National Association of Broadcasters (NAB), the engineering consulting firm Smith and Powstenko, Susquehanna Radio Corporation, and Westinghouse Broadcasting Company, Inc. ("Group W"). William F. Hammett, P.E., President of

² December 27, 1991, *ANSI Standards Actions* newsletter, at page 3.



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Hammett & Edison, testified in opposition to IEEE C95.1-1991, as did Mr. Kelly Williams of NAB and Mr. Michael Chiarulli of Capital Cities/ABC, Inc.³

8. On February 8, 1993, the BSR announced its decision: the appeals filed by Hammett & Edison, *et al*, were denied, and the November 18, 1992, adoption of the IEEE standard as an ANSI standard was affirmed.

9. Because ANSI has adopted the IEEE standard, Hammett & Edison does not oppose adoption of ANSI 1992 by the Federal Communications Commission. Although we continue to believe that certain portions of ANSI 1992 are flawed and are not justified by scientific evidence, ANSI 1992 will continue to exist whether or not the Commission adopts it. That standard has already been adopted by at least one local government agency (as IEEE C95.1-1991),⁴ and it seems inevitable that, if the Commission does not similarly adopt ANSI 1992, then many states, counties, and local governments would do so. Thus, Hammett & Edison believes that broadcasters and other users of radio frequency energy will have to live with ANSI 1992, no matter what action the Commission takes. Even if the local governments do not adopt ANSI 1992 specifically, broadcasters could still be subject to civil negligence suits for failing to meet its requirements. We would therefore rather see the Commission adopt ANSI 1992 as its guideline, with a temporary moratorium *for frequencies above 30 MHz* on the troublesome induced and contact current sections, until the Commission is satisfied that commercially available instruments exist that will permit the practical, reliable, and repeatable measurements of induced body and contact currents at frequencies above 30 MHz.

III. FCC Should Pre-Empt More-Restrictive Non-Federal Standards

10. A problem that Hammett & Edison has seen become more severe in the last few years is the imposition by state, county, and local governments of their own RFR standards that are more stringent than the guidelines adopted by the FCC, as well as the introduction of requirements for RFR measurements even when calculations show that there is no credible possibility of a proposed new station exceeding the FCC-adopted guidelines. The most common case has involved cellular radio towers in residential areas. The demand by local governments, typically planning or zoning boards, for actual measurements, even though conservative calculations predict maximum power densities two or more orders of magnitude below the ANSI limit for continuous

³ A copy of the exhibit prepared and filed by Hammett & Edison at the February 4, 1993, BSR hearing is included as Exhibit 1 to these comments. That exhibit was prepared to meet the BSR protocols requiring an appealing party to file ten copies of an exhibit supporting its reasons for objecting to the adoption of an American National Standard.

⁴ King County, Washington. See King County Ordinance No. 10021, Sections 10 and 13. Ordinance was adopted July 8, 1991, and became effective July 18, 1991.



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exposures, places an unnecessary burden on cellular common carriers attempting to establish new service or to improve existing service.

11. For example, we are aware of one statute, adopted by Multnomah County, Oregon, that requires measurements in all cases, stipulates that these measurements must be done only by a registered professional engineer,⁵ and requires continuous measurements for a 168-hour (7-day) period if the measurements show a level greater than one-fifth of the 200 $\mu\text{W}/\text{cm}^2$ level (*i.e.*, 40 $\mu\text{W}/\text{cm}^2$) allowed at VHF frequencies by the ordinance.⁶

12. There is no rational basis for requiring measurements when calculations made in accordance with OST-65 (or its successor) show predicted ground-level and rooftop-level power densities less than 1% of the generating station's ANSI 1992 limit for uncontrolled exposures. If the Commission should decide to pre-empt local standards requiring measurements in all cases, we suggest the 1% level as the pre-emptive predicted power density for which a local, county, or state level governmental body could not require actual measurements, once the station is constructed.

13. A classic case of a more-stringent RFR standard impacting broadcasters' mandate to serve their communities can be found for the TV stations atop the World Trade Center in New York City. That site is governed by the Port Authority of New York and New Jersey ("Port Authority"), which, in 1978, adopted a frequency-independent (*i.e.*, "flat") 100 $\mu\text{W}/\text{cm}^2$ exposure standard, 16 to 27 times (12 to 14 dB) more restrictive than the ANSI C95.1-1982 Standard at UHF television frequencies, and 3 to 5 times (5 to 7 dB) more restrictive than ANSI 1992. As a result, two UHF TV stations on the roof of the World Trade Center, WXTV, Channel 41, and WNJU, Channel 47, had to operate at half-power for over nine years, until the Port Authority commissioned a detailed, \$350,000 study⁷ of the rooftop power density levels that showed the UHF TV station's signals were generally not significant contributors to even the Port Authority's 100 $\mu\text{W}/\text{cm}^2$ standard. In 1989, the Port Authority therefore gave permission for both UHF TV stations to operate with their originally designed full powers of 3,200 kW for WXTV and 4,570 kW for WNJU. However, the Port Authority's determination that there was, in fact, no need for the UHF stations to operate at half power came too late for WXTV, which had already started the process to move to the Empire State Building, where that station is now located.

⁵ Multnomah County, Oregon, Ordinance MCC.7035(F)(4)(b)(v).

⁶ *Ibid.*, Section MCC.7035(F)(4)(b)(iii).

⁷ See "Measuring RF Levels in Complex Environments" by Dean W. Sargent, May 1993 *Broadcast Engineering*, pp. 36-44. Mr. Sargent is a consultant to the Port Authority and a consulting engineer based in Cherry Hill, New Jersey.



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14. Yet another example of excessively stringent exposure standards arbitrarily applied by local government agencies can be found in the case of FM Stations KPFA and KPFB, Berkeley, California. KPFA is a Class B station with transmitting facilities located in the East Bay hills on a tall tower, while KPFB is a Class A station with its transmitting facilities located on the roof of the building in downtown Berkeley that houses the combined studios for both stations. In 1990, KPFA/KPFB applied to build new studios at 1929 Martin Luther King Jr. Way, a move of approximately 0.6 kilometers from its old and overcrowded studios at 2207 Shattuck Avenue, Berkeley. This meant re-locating, as well, the KPFB antenna and the dish for KPFA's Aural STL Station WBS-379.

15. On March 12, 1990, a hearing was held before the Berkeley Board of Adjustments to determine whether Pacifica Foundation, the licensee of both stations, would be granted permission for its new studios. One of the issues identified in the hearing agenda was that of "radiation hazard." Hammett & Edison was then retained by Pacifica Foundation to prepare an exhibit addressing RFR issues. That exhibit demonstrated that, at the sidewalk level surrounding the proposed new studios, the RFR power density from the aural STL microwave station would be 0.0031% of the ANSI C95.1-1982 limit, and the RFR power density from the KPFB antenna would be 4.2% of the ANSI limit.

16. The Board of Adjustments voted to grant Pacifica Foundation approval of its proposed new studios. Unfortunately, that decision was appealed, with the issue of alleged radiation hazards from the KPFA aural STL station and KPFB figuring prominently in the appeal. In order to overcome the appeal, and to gain the blessing of a State of California Department of Health Services epidemiologist who had become involved in the RFR health issue claims, the design of the KPFB antenna was changed from circularly polarized with standard one-wavelength interbay spacing to horizontally polarized with half-wavelength interbay spacing. This reduced the predicted power densities at all publicly accessible areas to less than the then-existing Soviet RFR standard of 2.4 microW/cm^2 (at FM broadcast frequencies), at which point the epidemiologist indicated he would be willing to write a letter stating that there would be no health effects from the KPFA "microwave antenna" or from the KPFB FM antenna. Such a letter was written, on May 7, 1990, to the Berkeley City Council, and was a major reason why the Berkeley City Council denied the appeal and affirmed the Board of Adjustment's grant allowing Pacifica Foundation to build its long-planned new studios.



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17. It is for this reason that, although KPFB now has an effective radiated power of only 460 watts, that station nevertheless employs an antenna with half-wavelength interbay spacing and horizontal-only polarization.⁸

18. A potentially serious burden to broadcasters' ability to implement their Communications Act mandate to serve their communities has recently arisen in New Jersey. The State of New Jersey has just proposed to establish a mind-boggling bureaucracy to regulate RFR exposures, requiring all broadcasters and most other intentional emitters of radio frequency energy to register their facilities with the State of New Jersey and subjecting them to annual inspections for RFR compliance. On December 6, 1993, the New Jersey Division of Environmental Safety, Health and Analytical Programs ("DESHAP") proposed new rules⁹ that would require all radio and television station broadcasting antennas, including broadcast auxiliary stations, to pay an initial fee to register those antennas with DESHAP, and then to pay ongoing annual fees for DESHAP to perform measurements of the RFR power densities from these antennas. These fees are not trivial: \$440 initially to register each FM or TV broadcasting antenna, and \$400 per year thereafter; \$280 initially to register a point-to-point microwave antenna, such as a TV STL or ICR, and \$220 per year thereafter.¹⁰

19. The New Jersey DESHAP proposed regulations are the best example yet of why the Commission needs to adopt at least a limited preemption (discussed further below) of unreasonable non-federal regulation of RFR levels. Not only do the proposed regulations demonstrate DESHAP's inability to apply correctly the units of measurement for RF energy ("Wavelengths in the range of 300 Megahertz to 300 Gigahertz ..." ¹¹), by confusing wavelength and frequency, but they represent an unwarranted duplication of the RFR reviews already done by the Commission as part of its licensing process.

20. When the pre-emption issue has been raised in the past,¹² the Commission has held that it is not the expert agency on RFR biological effects, and for that reason has declined to pre-empt. That position is repeated in this Notice of Proposed Rule Making (NPRM), at Paragraph 8. While the FCC may not have the expertise to evaluate the biological effects of RFR on humans, it is

⁸ Copies of six letters documenting the above are included as Exhibit 2 to these comments.

⁹ New Jersey Administrative Code Section 7:28-48, *Fees for the Registration of Nonionizing Radiation Producing Sources* ("25 N.J.R. 5422"). New Jersey Register, December 6, 1993.

¹⁰ *Ibid*, 25 N.J.R. 5422, Section 7:28-48.7.

¹¹ *Ibid*, at Summary Paragraph 3.

¹² *Petition for Issuance of a Declaratory Ruling to Pre-empt State and Local Regulation of RF Radiation Standards that Affect Communications Services to the Public*, filed by NAB in 1986. The NAB request was dismissed on January 9, 1990 (FCC 90-10).



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certain that virtually all local governments, most counties, and a large number of state regulatory agencies also lack such expertise.

21. To avoid generating another patchwork quilt of more-stringent local RFR standards, Hammett & Edison submits that the Commission should pre-empt non-federal regulatory agencies from adopting any regulatory statutes, guidelines, or policies that are more stringent than those ultimately adopted in this proceeding. Existing RFR regulations that are more stringent than those adopted here should be superseded unless the state, county, or local government agency submits a showing to the Commission that it has expertise in the field of RF effects on biological tissues, that the need exists locally for more-stringent regulations, *and* that the agency has the infrastructure to administer and enforce such more-stringent regulations.¹³ This approach would be identical to that taken by the Commission in 1974, when it pre-empted more-stringent cable television technical standards that had been adopted by a growing number of local governments: a provision exists for a waiver of the pre-emption, if the state, county, or local governmental agency can demonstrate its expertise, the need for the more-stringent rules, and the ability to administer and enforce those rules.¹⁴

22. Thus, the proposed pre-emption would not be absolute. But the burden of demonstrating the reasonableness of, and need for, a more-stringent local RFR standard impacting FCC-licensed stations would be shifted to the local governing body proposing to burden broadcasters and other intentional emitters of non-ionizing electromagnetic radiation with more-stringent local standards.

23. Hammett & Edison believes that the Commission would receive few waiver requests. We believe that the staff burden of evaluating a small number of waiver requests would be much less than the number of requests the Commission would receive from unreasonably impacted broadcasters, cellular operators, and other Commission-licensed stations if yet another round of more-stringent local RFR regulations is allowed.

24. Hammett & Edison believes that, without federal pre-emption, such an ever-tightening spiral of more-stringent and unjustified local standards will inevitably arise. Local standards that

¹³ The Commission has demonstrated its ability to evaluate expertise claims by virtue of its recognition of the 1982 ANSI standard as a scientifically-based standard worthy of adoption by the FCC. This ability is re-iterated at Paragraph 3 of the instant NPRM.

¹⁴ See the October 22, 1974, Report and Order to Docket No. 20018, *In the Matter of Amendment of Part 76 of the Commission's Rules and Regulations Relative to the Advisability of Federal Preemption of Cable Television Technical Standards or the Imposition of a Moratorium on Non-Federal Standards*, at Paragraph 20. That paragraph stated that there would be "... built-in flexibility in the interim allowing for liberal waivers in those instances which (1) we have set no standard and there is a demonstrated state or local need for such a standard; or (2) our standard is demonstrably inadequate to meet clear state or local needs or conditions."



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are five or ten times more restrictive than ANSI 1992 would force many broadcast stations to come to the Commission for relief. While virtually no broadcast stations were impacted by the old 10 mW/cm² standard, and most broadcast stations were not seriously impacted by the present 1 mW/cm² standard, the “fat” in RFR standards will have been eliminated with the adoption of a 200 µW/cm² standard (*i.e.*, ANSI 1992). The adoption of more-stringent local standards with 100 or 50 µW/cm² limits would imperil the ability of broadcasters to carry out their Communications Act mandate to serve their local communities. Commission staff could easily be faced with many time-consuming cries for relief from unreasonable and unjustified more-stringent local standards.

25. Such a limited preemption would still be consistent with the National Environmental Policy Act (NEPA), which prohibits local governments from adopting environmental standards that are less stringent than federal standards but allows adoption of more-stringent environmental standards. Local governmental bodies that feel a need to adopt or to continue to enforce a more-stringent RFR standard than ANSI 1992 could still do so, after demonstrating to the Commission their expertise in the field of biological effects of non-ionizing electromagnetic radiation on humans and the need for such more-stringent standards, as reasonable “entry gate” criteria before exercising their NEPA option to adopt a more-stringent environmental standard. This would balance local governments’ NEPA rights with the Commission’s mandate in the Communications Act to make available “... to all of the people of the United States a rapid, efficient, Nation-wide, and world-wide wire and radio communications service ...”¹⁵

26. Hammett & Edison believes that the Commission must further pre-empt non-federal RFR standards or regulations that would needlessly duplicate the environmental review already performed by the Commission. The proposed New Jersey DESHAP rules are a classic example of this. If New Jersey is allowed to implement such an expansion of state-level bureaucracy in one fell swoop, it will inevitably lead to “me too” legislation by other states, determined to “protect” the residents of their state with similar regulatory schemes.

27. Hammett & Edison realizes that federal pre-emption is never popular with local governments and is not a step to be taken lightly by a federal agency. But now is the time to pre-empt, when most of the local standards are no more restrictive than ANSI 1992 now being considered by the Commission, and before the proposed precedent-setting New Jersey DESHAP rules take root and grow. The old saying, “An ounce of prevention is worth a pound of cure,” is perfectly applicable here.

¹⁵ Title I, Section 1, Communications Act of 1934, as amended (47 U.S.C. §151).



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28. In the event the Commission deems this request for a limited federal pre-emption to be beyond the scope of the Docket 93-62 rule making, Hammett & Edison hereby requests that this portion of its Docket 93-62 comments be treated as a Petition for Rule Making for limited pre-emption of non-federal RFR regulations, and that a Further Notice of Proposed Rule Making (FNPRM), or an entirely separate NPRM, be issued

IV. Inclusion Distances for RFR Studies

29. The Commission's rules and policies require all applicants who use engineering studies to demonstrate compliance with FCC RFR guidelines to consider in those studies all the non-categorically-exempted stations at their sites. In accordance with those rules and policies, Hammett & Edison carefully checks to ensure that all non-categorically-exempted stations contributing 1% or more of their individual ANSI limits at a site under study are included.

30. In the course of its practice, Hammett & Edison has had occasion to peruse numerous RFR studies prepared by others and has found remarkable the great variability in depth of review of such studies by the Commission staff. Sometimes a study will have been accepted for a station at an antenna farm when no consideration was made of the many collocated or nearby stations, while at other times a study will have been rejected for a station located by itself at a remote site when the staff's worst-case calculations do not agree with the antenna-specific calculations reported in the study. Explicit guidelines for including the possible additive effects of RFR from other stations nearby would help applicants to prepare their filings, as well as help the Commission staff to evaluate them.

31. To ensure a uniform application of the Rules, it is suggested that Section 1.1307 of the Commission's Rules be amended to specify distances applying to particular classes of broadcast and other non-categorically-exempt stations. It is suggested that every RFR showing filed on behalf of a non-categorically-exempt station be required to state whether there are any stations within these inclusion distances and, if so, to address the impact of such stations. The proposed inclusion distances are generally based on the main-beam illumination of a maximum power station that would cause 1% of that station's limit under ANSI 1992's limit for "controlled" environments.

32. Hammett & Edison suggests the following addition to the Code of Federal Regulations:

Section 1.1307(b), Note 4: Any party filing an engineering exhibit for the purpose of demonstrating compliance with the Commission's RFR guidelines shall state whether there are any stations of the types listed below within the distances



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indicated below. The engineering exhibit must account for the effects of any such stations in its calculations.

<u>Type of Station</u>	<u>Inclusion Distance</u>
AM Broadcast	1.0 km
Class D FM Broadcast	0.03
Class A FM Broadcast	0.2
Class B1 or C3 FM Broadcast	0.4
Class B or C2 FM Broadcast	0.6
Class C or C1 FM Broadcast	0.8
FM Translators over 100 W ERP	0.04
FM Boosters over 100 W ERP	0.4
VHF Low Band TV Broadcast	0.7
VHF High Band TV Broadcast	1.2
UHF TV Broadcast	3.2
VHF LPTV/TV Translators	0.06
UHF LPTV/TV Translators	0.35
Satellite Uplinks	0.05
ITFS/MDS/MMDS stations over 200 W EIRP	0.07

33. Further, it should be clarified that RFR studies must include all operational auxiliary (standby) antennas that may exist within the above inclusion distances. Also, the 200-watt equivalent isotropically radiated power (EIRP) trigger now specified for Instructional Television Fixed Service (ITFS), Multipoint Distribution Service (MDS), and Multichannel Multipoint Distribution Service (MMDS) stations should be clarified as applying to the *total* peak visual power of all channels assigned to the ITFS or MMDS station, as opposed to the per-channel power; thus, an ITFS or MMDS station with one 100-watt peak visual channel would be exempt, while a four-channel, 50-watt operation (combined peak visual EIRP of 200 watts) would not be.

V. Impact of 100 MHz Break Point for Induced and Contact Currents

34. As previously mentioned, Hammett & Edison believes that there is no justification for extending the limits on induced and contact body current above 30 MHz. Nevertheless, ANSI 1992 does so and extends these provisions to 100 MHz, the middle of the FM broadcast band, which is the largest group of high-power intentional emitters of RF energy in the United States.

35. This is arbitrary and capricious on its face. If induced and contact currents are actually a problem at VHF low-band and FM frequencies, then how could IEEE justify requiring a 6-kilowatt



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Class A FM broadcast station at, say, 99.9 MHz to measure for induced and contact currents, while ignoring such effects for a 100-kilowatt Class C FM station at, say, 100.1 MHz?

36. The NPRM proposes to address this inconsistency in ANSI 1992 by requiring all FM stations located at a single site, regardless of carrier frequency, to demonstrate compliance with the induced and contact current provisions, if one or more of the stations operates below 100 MHz. However, if the Commission adopts ANSI 1992, then wherever there is a non-categorically-exempted emitter below 100 MHz (either FM or low-band VHF TV, TV Translator, or LPTV), *all* stations at that site, including FM stations on frequencies over 100 MHz, high-band VHF stations, UHF stations, and ITFS/MMDS stations, need to address the issue of induced and contact currents. Just as the Commission's current policy that all non-categorically-exempted stations at a site bear a shared responsibility for determining and mitigating RF exposure conditions for the entire site (subject only to the Docket 88-469 1% exclusion), application of the identical logic to the matter of body currents would lead the Commission to require all non-categorically-exempted stations to bear a similarly shared responsibility for determining and mitigating body currents for the entire site (subject, perhaps, to some exclusion criteria yet to be developed). In other words, a below-100 MHz station "contaminates" that site for all stations there, not just those below 100 MHz, or even those below 108 MHz.

37. The new requirements in ANSI 1992 that place limits on induced and contact body currents are likely to be devastating to broadcasters if the Commission does not declare some reasonable limits regarding sufficient and complete showings demonstrating compliance with the new standard. For example, ANSI 1992 does not define the impedance of a "standard person" at VHF frequencies, which would allow consistent modeling of induced and contact currents.¹⁶ Indeed, Figure A6 in the new Standard, showing the impedance ranges applying to an adult male, adult female, and ten-year-old child, extends only to 3 MHz (and the axis itself stops at 10 MHz), while the induced and contact body current limits apply at frequencies up to 100 MHz!

38. Without authoritative guidance from the Commission, it may prove necessary to make measurements of induced and contact body currents at *every* broadcast site in the United States with a below-100 MHz station at the site, and on every broadcast tower in the United States with a below-100 MHz station. Given that there are approximately 5,000 AM stations, 6,300 FM stations, 1,500 TV stations,¹⁷ 5,000 TV Translator stations, and 1,000 Low Power Television

¹⁶ Nor does the companion IEEE Standard, C95.3-1991, *IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields—RF and Microwave*.

¹⁷ 1993 Broadcasting & Cable Yearbook, pages B-590 (radio) and C-226 (television).



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(LPTV) stations,¹⁸ the cost of making site visits solely to measure induced and contact currents could easily exceed \$14 million, assuming that half the sites have stations below 100 MHz and assuming an average of 5 stations per site and a cost of \$7,500 per site visit. Visits to remote sites or to complex antenna farms would cost even more. There are no demonstrated public safety considerations that would warrant the cost of such a widespread program of measurements.

39. At the December 1-2, 1993, meeting of SC-4 in Las Vegas, Nevada, it was recognized that there were certain power density levels for which the induced current portion of ANSI 1992 could not possibly be exceeded, and therefore no induced current measurements should be required. The following exclusion percentages of the maximum permissible exposure (MPE) were proposed:

<u>Frequency</u>	<u>MPE Exclusion Level</u>
<450 kHz	100%
540 kHz	82
1700 kHz	26
~60 MHz	15
90 MHz	36
100 MHz	42

Thus, under this SC-4 proposal, a site with an FM station below 100 MHz but with no VHF low-band TV stations would not have to bear the expense of measuring for induced body currents if the site does not exceed 36% of the MPE. For on-tower exposures, measurements of induced body currents could be avoided if protocols were adopted to allow no on-tower access for MPE's exceeding 36% instead of 100% (possibly subject to an exclusion for workers wearing RF protective clothing, discussed further below).

40. Unfortunately, no agreement could be reached on a similar exclusion level for contact current measurements. Some SC-4 members felt that excessive contact currents could exist even in fields otherwise well below the E-field (or H-field) maximums. Although Hammett & Edison believes that this is a problem only *below* approximately 30 MHz, where the longer wavelengths can induce a non-compliant contact current (>100 mA) if a large conducting object is oriented unfavorably in the presence of a nearby AM station (for example, a window washer's wire rope on a tall building, or dockyard cranes), it is not believed that the problem exists at VHF frequencies. Perhaps SC-4 will be convinced to adopt a similar MPE-driven exclusion from having to measure for contact

¹⁸ Office of Public Affairs, Consumer Assistance & Small Business Division, FCC August 1991 LPTV *Fact Sheet*, at page 1.



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currents at sites with only above-54 MHz emitters. However, until that occurs, adoption of ANSI 1992 by the Commission with no moratorium for induced and contact current measurements would require seemingly all broadcast station site in the United States to be measured for *contact* currents.

41. Since TV Translator and LPTV stations are not categorically exempted from having to routinely demonstrate compliance with the Commission's RFR guidelines, even these relatively low-power stations could be forced to bear the cost of at least contact current measurements if the Commission does not adopt the requested moratorium, in addition to the previously discussed moratorium for enforcing the induced current portion of ANSI 1992 for frequencies above 30 MHz.

42. Lacking an officially recognized algorithm for predicting induced currents (for MPE's exceeding those of Paragraph 39) or for predicting contact currents, we believe that a broadcaster or licensee of a non-categorically-exempted station (*e.g.*, satellite uplink, or ITFS/MMDS station with more than 200 watts EIRP) that has a below-100 MHz station at its site could not certify compliance without making ground-level *and* on-tower measurements of induced and contact currents.

43. Even if the MPE exclusion levels for *induced* current measurements are ultimately adopted by IEEE, it will be of little help to broadcasters, cellular radio operators, and other Commission licensees because broadcasters and licensees of other non-categorically-exempted stations with below-100 MHz emitters at their site would still be subject to contact current measurements for on-tower exposures,¹⁹ where often significant power cutbacks by nearby stations are necessary to achieve even 100% of the MPE, let alone some small fraction of the MPE.

44. Yet another justification for the Commission to adopt a moratorium on enforcement of the body current portion of ANSI 1992 for frequencies above 30 MHz is the lack of reliable, commercially available devices to measure this parameter. For example, the Narda Model 8870 contact current meter is only designed to measure contact currents up to 30 MHz, which is almost two octaves short 100 MHz.

¹⁹ At the December 1-2, 1993, meeting of SC-4, Co-Chair Dr. E. R. Adair expressed her opinion that the induced current portion of ANSI/IEEE C95.1-1992 does not apply to on-tower exposures, apparently on the rationale that a freestanding individual not in contact with metallic objects could not exist on a broadcast tower. While this position appears to ignore the possibility of non-metallic platforms at height on a broadcast tower, the concern regarding the impracticality of measuring induced body currents at VHF frequencies for workers on a tower will have been overcome if this position is ultimately affirmed by the Interpretations Working Group of SC-4. This would not, of course, eliminate the contact current measurement problem.

VI. Need for Standardization of Body Current Measurements

45. There is one aspect of ANSI 1992 that field tests made by Hammett & Edison at frequencies below 30 MHz have already shown not to be conservative, which the Commission should modify when that standard is adopted. ANSI 1992 assumes that body current through one foot is half that through two feet; actual measurements, and theory, show otherwise. As documented by the Pages 2 and 3 to the attached Exhibit 3, measurements taken near an AM station and near a 2 MHz amateur radio station using a prototype "RF boot" showed, for example, currents of 45 mA in each leg (90 mA total, equaling the ANSI 1992 guideline for uncontrolled areas) increasing to 78 mA in one leg when the other is raised above the ground. Thus, one might conclude, from a two-foot measurement, that the induced currents are in compliance, when in reality this would *not* be the case as soon as the person begins to walk, at which time only one foot will be in contact with the ground. The Commission should specify that, where conditions require the measurement of body currents, such measurements should only be taken through one foot (*i.e.*, with the other foot raised), and not through both feet.

46. Induced body current measurements need to be repeatable. As shown by Page 4 of Exhibit 3, the height of a person in a given RF field and the footwear of that person significantly affect the magnitude of the induced current. The addition of a ground strap from the wearer's ankle to the RF boot eliminates the variabilities caused by the interface with the RF boot (*e.g.*, type of footwear, with or without socks, dry or sweaty feet) and is conservative; that is, the readings of induced current with the strap are not exceeded by any other interface condition, including that of bare feet. The attached Figure 1 shows a photograph of the ankle-to-RF boot interface. Hammett & Edison has also found that, if the person making the induced current measurements simply extends one hand to a uniform height above ground, such as 2 meters (6.6 feet), the variability caused by the height and size of the person making the measurements is largely eliminated. We therefore recommend that these two measurement protocols, ankle strap and uniform height, be adopted by the Commission as recommended practices when measuring at AM broadcast station sites.

47. A more serious problem exists for induced current measurements at VHF frequencies. Field measurements taken²⁰ in cooperation with Mr. Alan W. Parnau, P.E., of CBS Radio on November 17, 1993, at San Bruno Mountain, California, indicated that a reliable, repeatable, commercially-available VHF induced body current meter does not yet exist. Tests taken using a prototype Narda Model 8850 Induced Current Meter showed variability between persons standing

²⁰ It is believed that the CBS Radio comments will report in considerable detail on the results of the San Bruno Mountain induced current measurement tests, as well as similar measurements taken at several other broadcast station sites throughout the United States.

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on the meter, non-symmetrical currents between left-foot only and right-foot only conditions, variability due to the interface between the meter and the ground, meter “zeroing” problems (including “negative” induced current indications!), and sensitivity to relatively low power emissions above 100 MHz.

48. For example, variabilities greater than two-to-one were found between both-feet/shoes-and-socks induced currents and both-feet/bare-feet induced currents. Significantly different currents were obtained by raising one arm and both arms above one’s body. The induced current changed from approximately 15% of the induced current MPE to approximately 70% of the induced current MPE when a 2-watt 450 MHz walkie-talkie was keyed on approximately 2 feet above the meter. The attached Figure 2 demonstrates some of the various body positions used with the prototype Narda meter (which, as a factory prototype, had no serial number or calibration sticker).

49. For these reasons, Hammett & Edison believes that, while the Commission should adopt ANSI 1992 as its processing guide, it also needs to apply a moratorium for the induced and contact current portions of the Standard at VHF/UHF only sites; that is, sites with emitters above only 30 MHz. The induced and contact current portions of ANSI 1992 can reasonably be implemented now for stations below 30 MHz, that is, AM broadcast stations, as the measurement of induced and contact currents at AM frequencies is presently practical.

50. The moratorium should remain in effect until the Commission finds that practical, repeatable, commercially available, 100 MHz induced and contact current meters are available, at which time an order terminating the moratorium should be issued by the Commission.

VII. RF Protective Clothing

51. A ray of hope for broadcasters and other intentional emitters of radio frequency energy is the possible recognition by the Commission of protective clothing as an acceptable mitigation measure. In an April 14, 1993, letter to the Commission, the Occupational Safety and Health Administration (OSHA) appears to have endorsed the use of radio frequency (RF) protective clothing made from NAPTEXTM, a specialized metallic-fiber material designed to protect the wearer against high RF fields.

52. If the Commission finds that such protective clothing, which includes coveralls, hood, gloves, and footcovers, applies to near-field conditions where the E- and H-fields may no longer be orthogonal, and is also effective for induced and contact body currents, then the otherwise immense difficulties created by the ANSI 1992 for on-tower induced and contact current limits will have been largely ameliorated. While this would result in a *de facto* requirement for all non-categorically-



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exempted stations to permit on-tower access only by workers wearing an RF protective suit, at a nation-wide regulatory cost of approximately \$3.5 million for the broadcasting industry (18,800 non-categorically-exempted broadcast stations divided by 5 stations per site times 1 suit per site times \$920 per protective suit), this is still far less burdensome than the previously estimated \$14 million cost should all sites with below-100 MHz stations require a site visit to make induced and contact current measurements.

VIII. Adoption of ANSI C95.3-1991

53. At Paragraph 28, the NPRM asks if ANSI C95.3-1991, "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields– RF and Microwave," should also be adopted as an FCC guideline. Hammett & Edison believes that the answer to that question should be "yes." While ANSI C95.3-1991 is not as helpful as it could be, because of its failure to define a "standard man" so as to limit the universe of human sizes that could be placed in a given RF field for induced body current measurements, we have no difficulties with any of the measurement protocols that are included in ANSI C95.3-1991. Indeed, we particularly applaud the minimum separation distance of 20 centimeters specified in Section 5.3.6.3 for near-field survey instruments.

IX. Conclusions

54. Hammett & Edison agrees that there is a need for the Commission to update its RFR guidelines to reflect the latest ANSI standard. Because ANSI/IEEE C95.1-1992 will continue to exist, whether or not the Commission adopts that standard as its new processing guide, we believe that the Commission should adopt it as is, but with a moratorium on the problematic induced and contact current portions of that standard for above-30 MHz emitters. It is imperative that the Commission adopt a limited federal pre-emption, to ensure that city, county, and state governments are not able to circumvent actions taken by the Commission in this proceeding by adopting unreasonable or duplicative regulatory schemes.

X. List of Figures and Exhibits

55. The following exhibits and figures have been prepared and are included as a part of these Hammett & Edison Docket 93-62 comments:

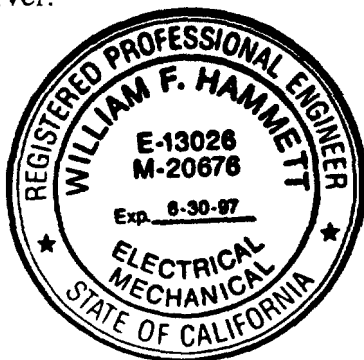
Figure 1. Photograph showing recommended interface between ankle and RF boot for induced body current measurements below 30 MHz.

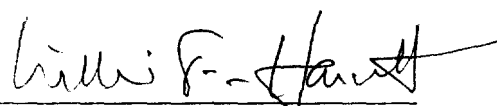
Figure 2. Photographs showing prototype Narda Model 8850 Induced Current Meter and various body positions used to gain experience with the meter.

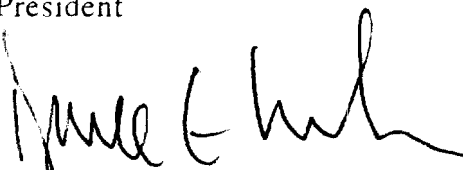


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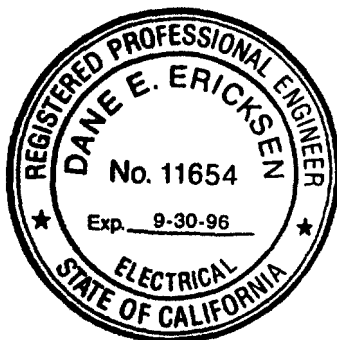
- Exhibit 1. Copy of February 4, 1993, Hammett & Edison exhibit submitted to the Board of Standards Review in support of its appeal against adoption of IEEE C95.1-1991 as an American National Standard.
- Exhibit 2. Copies of six letters concerning FM Stations KPFA/KPFB, Berkeley, California, regarding showing of compliance with the Soviet RFR standard of $2.4 \mu\text{W}/\text{cm}^2$ in order to obtain local zoning board approval.
- Exhibit 3. Copies of four figures presented at the April 21, 1993, NAB Engineering Conference session "Meeting IEEE C95.1-1991 Requirements," by William F. Hammett, P.E., showing measured relationships between induced RF currents in two feet versus one foot, among various interfaces to ground, and among various effective heights of the observer.




William F. Hammett, P.E.
President


Dane E. Ericksen, P.E.
Senior Engineer

January 21, 1994



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Ankle-to-RF Boot Interface

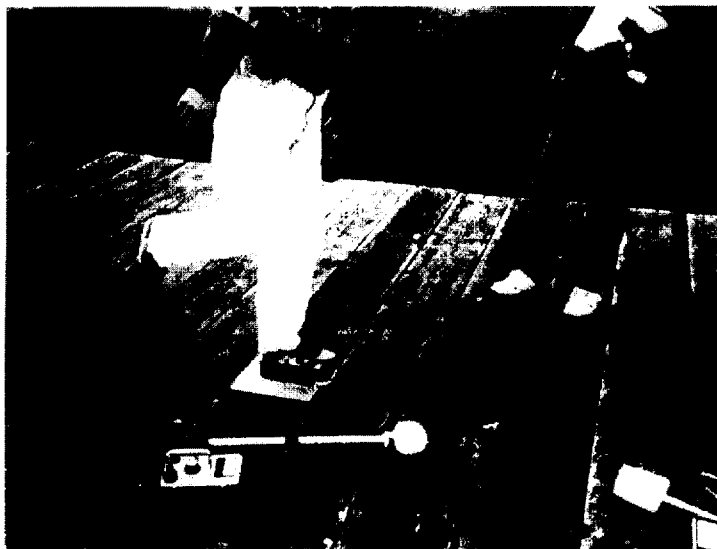


This photograph shows the conductive strap, made of flexible copper braid, wrapped around the ankle of an engineer wearing one of the Hammett & Edison prototype RF boots, designed to measure induced RF currents at broadcast station sites. The copper strap ensures a good interface between the engineer and the RF boot, to eliminate that parameter as an unknown variable when making induced current surveys at AM sites.

Tests of Prototype Induced Current Meter



Prototype version of Narda Model 8850 Induced Current Meter used at San Bruno Mountain antenna farm measurements on November 17, 1993. Meter provided courtesy Loral Microwave-Narda and Mr. Alan Parnau, P.E., of CBS Radio, New York City.



Example of one of several body configurations used to ascertain effect on magnitude of induced RF currents. A Holaday Model HI-3001 broadband exposure meter and a Narda Model 8716 broadband exposure meter are in the foreground. These meters were used to measure the E-field power density levels at various heights above the induced current meter.

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Tests of Prototype Induced Current Meter



Example of the both-feet, hands-at-side, with-shoes/socks body position.



Example of the one-foot, hands-in-air, with-shoes/socks body position.



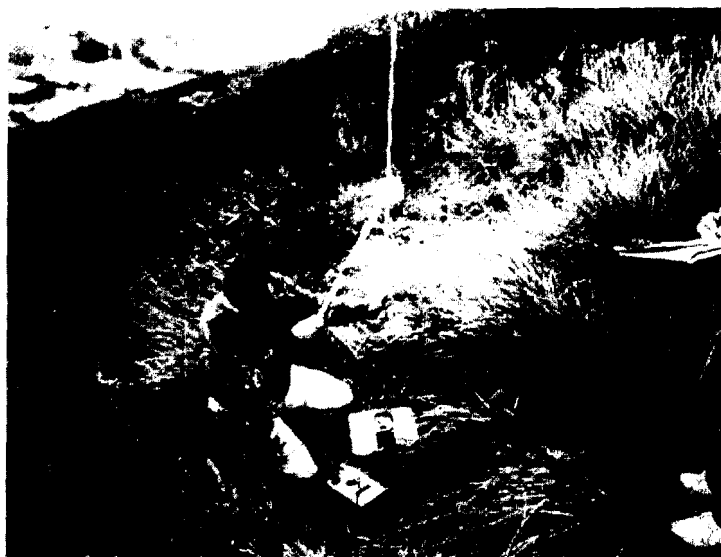
HAMMETT & EDISON, INC.
CONSULTING ENGINEERS
SAN FRANCISCO

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Tests of Prototype Induced Current Meter



Example of the one-foot, hands-at-side, bare foot body position.



Measuring E-field power density levels at 1-foot increments above Narda 8850 induced current meter. Measuring rod is non-metallic.

